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Nebraska Collegiate Methods Professors' Perceptions of the Next Generation Science Standards: A Semi-Structured Interview Approach

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by

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Abstract

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University of Nebraska, 2017

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This study utilized a semi-structured interview approach to identify how college methods professors in Nebraska are engaging pre-service K-12 teachers with the Next Generation Science Standards and to determine if this information is being carried over to Nebraska K-12 classrooms. The study attempted to address these items by answering the following research questions. First, what level of exposure and knowledge do methods professor have with regard to NGSS, and what are their perceptions? Second, what specific instructional strategies are college professors implementing to inform pre-service teachers about NGSS? Finally, are methods professors observing the three dimensions of NGSS carry over into the classroom during their students' field experiences? Nine science methods professors were interviewed from across the state of Nebraska. The interviews were transcribed and analyzed for common themes in responses, and those themes were then used to answer the three research questions that were posed by the study. There were five themes identified from the research. Those themes included lack of NGSS-specific professional development for methods professors, confusion surrounding the cross-cutting concepts dimension, instructional impacts of NGSS, including more hands-on science occurring in the classroom and greater science emphasis

at the elementary level, limited instructional strategies being utilized, and finally, the influence of cooperating teachers on field experience observations.

The researcher identified a need for an increase in the amount of NGSS training available for post-secondary instructors, a need to create clarity in the vocabulary and among the various dimensions of the standards, and the importance of creating quality field experience placements for our pre-service teachers to ensure a continuation of their learning. Implications for further research were explored and included an investigation of professional development opportunities at the post-secondary level. Additionally, a study involving the breaking down of the language of the standards, and using that information to develop a user's guide for navigating and decoding the standards would be prudent.

Dedication

This project is dedicated to my two amazing daughters, Mia and Harper. You two are by far and away my greatest accomplishments and I am very proud to be your mom. May you always remember to follow your dreams and know that anything is within your reach as long as you are willing to work for it and never give up. I love you both to the moon and back! -Mom

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The last four years have been an incredible journey. When I started I was naïve about the amount of time and work that would go in to this project. It has been by far and away the most challenging and most rewarding intellectual experience of my life. There are many people that I need to thank for their support and assistance in this process.

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We are at critical point in science education, and it is my hope that this research has served to shed some light on the progress and pitfalls that have been experienced thus far. Change is slow and change is hard, but through the dedication and hard work of educators in the classroom and through proper preparation at the collegiate level, we can facilitate a meaningful, productive change that will benefit students and promote science as an interactive, skill-based discipline.

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Chapter 1: Statement of Problem

Introduction

The current national goals for science education in the United States, according to the National Research Council, include increasing the number of students pursuing science majors and degrees at the post-secondary level, increasing the participation of minorities and women in the science field, and improving science literacy across the board for all students (NRC, 2012). The Next Generation science standards were written to specifically address these goals and enable all students to actively engage in the practice of science. The standards were published in 2013, based on a framework for science education that was developed by the National Research Council. The goal of these standards was to provide a new approach to science education where students are incorporating engineering and science in performance-based settings. The fundamental content of science courses, based on NGSS, has been stream lined and focused on a small set of disciplinary core ideas that can be interconnected and related through a teaching method referred to as crosscutting concepts (Bybee, 2014). The NGSS was developed as a means to remedy the curricular continuity and informational retention issues of the current science educational format in the United States. These standards are designed to interconnect scientific ideas, make learning an interactive, performance-based endeavor, and provide opportunities for students to master a core set of scientific ideas that will carry them into their futures with the ability to think critically and problem solve.

"Curriculum coherence is the most dominant predictive factor of student learning as measured by the TIMSS" (Schmidt & Prawat, 2006, p. 641). In order for students to decipher and retain information regarding the complex processes and concepts that make up the whole of science, they need to be explicitly taught how all of the scientific subject

areas are interconnected. The more connections that are made for them, within and amongst ideas, the more fluid and manageable these ideas become and the more likely students are to hold on to those ideas over long periods of time. “Introducing scientific concepts in authentic and relevant contexts makes science meaningful, enhances intrinsic motivation, and fosters students’ learning” (Shwartz, Wiezman, Fortus, & Reiser, 2008, p. 200). The Next Generation Science Standards were written to intentionally interconnect scientific ideas and give students the opportunity to put those ideas into practice to make them authentic and meaningful.

The approach that NGSS takes with regard to presenting and interacting students with scientific information creates a substantial shift in instructional pedagogy and traditional science curricular development and implementation. NGSS challenges the way science has historically been taught in American education institutions by tearing down the walls between the silos of science and approaching science as a whole discipline (Growther, 2016). Future science teachers will need to be thoroughly trained on how to properly implement these standards to ensure that they are implemented effectively and utilized for their intended purpose (Willard & Workosky, 2015).

Teacher preparation programs at the post-secondary level are a first line of exposure for new teachers, as these programs influence how and what new teachers will be bringing to their classrooms. An analysis of teacher prep programs will provide information as to how methods professors are exposing their students to NGSS and how that information is being transmitted into Nebraska classrooms. There is a legitimate dearth in the literature with regard to how teachers are being trained to effectively utilize the Next Generation Science Standards from an instructional perspective.

Purpose of the Study

The Next Generation Science Standards (NGSS) were published in April 2013 with the intention of re-configuring the way science is being taught in American schools. The premise behind NGSS was to provide the basis for science to be taught in a more in-depth, performance-based, coherent manner. Though these standards are lesser in number compared to previous standards documents, they require a greater focus on skills and practices, and they emphasize a richer, more connected curriculum in the classroom (Achieve, 2014). The instructional and curricular shift that is suggested by NGSS will require changes to be made in the way that teachers are designing and carrying out daily lessons. The appropriate implementation of these changes will be a contributing factor to the ultimate success of NGSS (Rodriguez, 2015). NGSS will require teachers to make changes in curriculum and pedagogy to align their thinking and instruction with the goals and format of the standards.

In order to positively impact student achievement, it will be critical that these dimensions be implemented in a consistent, systematic manner. In order for this to be achieved, teachers need to be informed of the critical elements of NGSS. They will also need to be properly educated and exposed to this new type of instructional model for science education. Implementing these standards will require a much greater depth of knowledge on the part of teachers (Pruitt, 2014). They will need to have a clear idea of how these specific dimensions are to be approached instructionally and how they will be used to ensure that the standards are being implemented to their full potential to positively impact student achievement. How we prepare and inform our teachers about NGSS will ultimately determine the success of these standards (Cooper & Padilla, 2012).

There is a dearth in the literature as to how teachers are being trained at the college level to implement the Next Generation Science Standards. There is lack of research with regard to how science methods professors are engaging their students with NGSS and how that information is influencing teacher practice in the field. According to an article written by NGSS authors with regard to connecting the instructional framework to the standards, "College of education students need to be prepared to use, interpret, and implement NGSS in their future classrooms" (Cooper & Padilla, 2012, pg. 7). No research has been published as to how this preparation of pre-service teachers is being addressed or if the methods currently in place have been effectively influencing teacher practice. There is a need to gather information on how teachers are being trained to implement NGSS and how that training is influencing their practice. The purpose of this study was to identify how college methods professors in Nebraska are engaging pre-service K-12 teachers with the Next Generation Science Standards and to determine if this information is being carried over to Nebraska K-12 classrooms.

Research Questions

The following research questions were used to determine the level of experience and knowledge that is possessed by methods professors with regard to the NGSS, the type of information, the amount of engagement that methods professors are using in their courses to expose pre-service teachers to NGSS, and the degree to which this information is being utilized by pre-service teachers in their experiences in the field.

Research Question #1. What level of exposure and knowledge do methods professors in Nebraska have with regard to the Next Generation Science Standards and what are their perceptions of the standards?

Research Question #2. What specific activities, lessons plans, and information from syllabi are being implemented by methods professors to engage pre-service teachers with NGSS?

Research Question #3. To what degree do methods professors see new teachers carrying over the three dimensions of NGSS into the classroom in their student teaching and practicum experiences?

Limitations of the Study

The sample for this study was confined to science methods professors from post secondary institutions in the state of Nebraska who have teacher preparation programs. This small sample size limited the utility and generalizability of the study results and findings.

Delimitations of the Study

The study was delimited to science methods professors in the state of Nebraska at post secondary institutions with educational teacher preparation programs. These professors were teaching methods courses during the 2016-2017 school year and in some cases also had student teaching and or practicum observation responsibilities. Study findings were limited to professors who have accepted an invitation to participate in the interview process for this study.

Operational Definitions

Exposure*:* situations where methods professors have been intentionally engaged with learning about the standards from a teaching perspective.

Knowledge: a professor's ability to translate and dissect the standards in a meaningful way for his or her students.

Implemented: the intentional utilization of a strategy or idea to relay a specific idea.

Degree: How often and at what level something is occurring.

Chapter 2: Overview of the Literature

This review of literature outlines the purpose and implementation of new educational standards in science; it discusses the key aspects of the Next Generation Science Standards and the intended purpose of these standards. This review briefly discusses the implementation of the Next Generation Science Standards and the importance of providing proper education and training for pre-service teachers with regard to utilizing the standards. After a thorough review, a dearth was found in literary research with regard to teacher implementation of the Next Generation Science Standard sand how pre-service teachers should be trained and educated with regard to teaching in light of NGSS. This study is intended to fill this void in the research by providing information about how pre-service teachers are being trained to understand and implement the various aspects of NGSS and also how this information is being carried over to the classroom.

Background

Science education provides an avenue for students to engage with fundamental skills such as problem solving, critical thinking, data analysis, and questioning. Today's citizens are required to use science and technology frequently, weather it is for personal, societal, or professional reasons (NRC, 2010). Scientific literacy is important to the functioning of our society and ensuring that we are creating a work force that is prepared to face the needs of a growing, technologically advanced world. According to the US Department of Education, today's schools are not graduating enough students with the skills necessary to fill the work force demands for science, technology, engineering, and mathematics. They have also found that society as a whole is inadequately prepared to

address and understand the many scientific-based issues and concerns that the nation is currently facing (USDOE, 2011).

The National Research Council created the Next Generation Science Standards in an effort to address these issues. The primary goals of NGSS are to improve college preparation, STEM career readiness, and ability of all members of society to make informed decisions (NSTA, 2013). The Next Generation Science Standards (NGSS) are focused on engaging students in a problem solving process to explore and explain scientific ideas. NGSS varies significantly from previous standards' documents in seven fundamental ways. First, science concepts reveal the interconnected nature of science and are practiced in a manner consistent with the way science is practiced in the field, they are considered performance expectations, not curriculum; they build coherently and facilitate a deeper understanding and application of ideas; and they provide a strong presence of engineering integration, college prep emphasis, and alignment to Common Core. These standards will provide teachers with a blueprint for creating a scientifically relevant and retainable curriculum for students (Milano, 2014). "The focus must shift from what we know to how we came to know and develop scientific knowledge and why we believe what we know. Doing science involves conceptual knowledge, scientific reasoning, understanding how scientific knowledge is produced and participating in science" (Duschl, 2008, pg. 48).

Three Dimensions of NGSS

The Next Generation Science Standards are composed of three dimensions that are intended to reorganize the way science is currently being taught. Implementation of the dimensions requires change to be made with regard to learning objectives,

instructional strategies, and assessments. The dimensions include: Disciplinary Core Ideas, Science and Engineering Practices, and Cross Cutting Concepts.

Disciplinary Core Ideas

Disciplinary Core ideas are defined by NGSS as the most important aspects of K–12 science curriculum, instruction and assessments that can be organized into four domains: the physical sciences; the life sciences; the earth and space sciences; and engineering, technology and applications of science (NGSS Lead States, 2013). In an effort to streamline and condense the amount of science content that is being taught in United States' schools, the standards have identified the disciplinary core ideas (DCI) for each of the four scientific curricular areas. These ideas are limited to four per core area and they are complex and multi-dimensional. The purpose of DCIs' was to provide opportunities for teachers to expand on ideas over the course of a student's academic career. DCIs' have the capacity to promote in-depth explanation and exploration (Bybee, 2013). In the next generation of science classrooms, "students are actively engaged in the practices of science and engineering, using design as a vehicle to build and revise knowledge of key disciplinary core ideas" (Milano, 2014, pg. 10). Focusing students on those principles that govern science and allowing them to investigate and explore their questions about those principles is a foundational goal of this dimension. "Taken together, the DCI's create a conceptual tool- kit that students can use to reason about and explain phenomena" (Cavera, 2015).

Science and Engineering Practices

Science and Engineering Practices are defined by NGSS as the behaviors that scientists engage in as they investigate and build models and theories about the natural

world, and the key set of engineering practices that engineers use as they design and build models and systems (NGSS Lead States, 2013). This dimension focuses on the "doing" of science. Its purpose is to build knowledge and develop explanations of scientific phenomenon through scientific investigation in a limited-structure format. This provides opportunities to generate new, valid, and reliable knowledge by engaging students in the exploratory nature of science with the hope that they will not only obtain new knowledge, but that they will formulate new questions, as well (Bybee, 2011).

Crosscutting Concepts

Crosscutting concepts is defined by NGSS as a way of linking the different domains of science that provides an organizational schema for interrelating knowledge from various science fields into a coherent and scientifically-based view of the world (NGSS Lead States, 2013). Crosscutting is about creating a fluid picture of science where ideas and principles from one scientific discipline are interconnected to other disciplines. The goal is to create connects for students within the content of an individual course, as well as to make connections to content from other courses. Creating a cohesive picture of science improves retention of information, and it makes science a more holistic discipline (Cozzens, 2015). Investigating scientific phenomenon from different perspectives creates new insight and reinforces the key ideas and governing principles of the discipline. Crosscutting Concepts is a method for teaching Disciplinary Core Ideas in a meaningful way (Duschl, 2008).

Implementation

The successful implementation of NGSS will require a significant shift in instruction, curriculum, and teacher preparation. Pre-service teachers will need to be

intentionally trained on instructional best practice involving performance expectations and evidence-based assessment development (Penuel, 2015). Quality curricular materials will need to be utilized in training to show teachers how to incorporate the various performance and skill-based aspects of NGSS. New teachers will need to be properly and adequately instructed on how to effectively implement these standards. This will require extensive knowledge and experience on the part of post-secondary professors working with pre-service teachers (Padilla, 2012).

Pre-service Teacher Training and Education

According to a statement published by the NSTA, it is their recommendation that professors of higher education take on the following responsibilities with regard to the successful implementation of NGSS: obtain an in-depth understanding of the standards and ensure that program requirements are aligned with the student acquisition of this knowledge, use instructional strategies at the post-secondary level that demonstrate the coherent learning progressions of science and allow students to engage with performance expectations, model the use of science and engineering practices, and ensure that new teachers enter the field with the skills necessary to properly utilize, implement and communicate the standards (NSTA, 2013).

Adoption and implementation of the Next Generation Science Standards has a direct impact on how teachers are being trained and prepared at the college level. "Effective science teaching is more than the level of knowledge about science and engineering practices, crosscutting concepts, and disciplinary core ideas. The next generation of science teacher educators should attend to the entire constellation of competencies and qualities that contribute to effective teaching and learning" (Bybee,

2014 pg. 221). Pre-service teachers need to learn how to integrate knowledge and practice in a manner that is content-relevant, which is a challenge to be addressed by post-secondary educators. "As teachers of college-level science courses, it will be our job not only to prepare new teachers to teach at the level and focus of the new standards, but also to provide a continuation of the approach begun by the NRC Framework to make science and engineering more relevant, more accessible, and more important to the next generation" (Padilla, 2012, p. 41).

Chapter 3: Methodology

Participants

Research was conducted using post-secondary K-12 science methods professors in the state of Nebraska. Some of the professors that participated in the study were also involved in the supervision and evaluation of student teachers and/or practicum students. There are currently sixteen institutions in the state of Nebraska that offer a Bachelor's in Education Degree: Chadron State, College of Saint Mary, Concordia University, Creighton University, Doane College, Grace University, Hastings College, Midland Lutheran College, Nebraska Wesleyan University, Peru State College, Union College, University of Nebraska- Kearney, University of Nebraska- Omaha, University of Nebraska-Lincoln, Wayne State College, and York College. The study interviewed nine science methods' professors from eight of these institutions. Years of experience at the post secondary level will be noted for coding purposes, but not used as a delimiting factor in the study. These professors were chosen to provide the data for this study because they represented a pre-service teacher's first exposure to standards-based teaching. Their instructional choices influence what and how new teachers in the field will be approaching science instruction in their classrooms. The amount of exposure pre-service teachers are getting to new standards is directly influenced by the information and instruction they are getting from the college professors who are preparing them for the classroom (Ferrini-Mundi, Burrill, & Schmidt, 2007). Methods professors have been chosen for this study so the researcher can determine exactly if and at what level pre-service teachers are interacting with the Next Generation Science Standards. Through

the analysis of their methods and instruction, this study served to unveil the current conditions of NGSS in the state of Nebraska.

Nebraska was chosen as the sole state participating in the study due to the unique circumstance that surrounds its public educational system. Nebraska does not utilize the Common Core Standards set out at the federal level. Nebraska is one of only eight states that have not adopted the common core state standards as of 2016 (NDE, 2016). Nebraska state officials review the state's academic standards every five years for weaknesses and continue to maintain their own, unique set of standards that the state considers to be rigorous and college/career ready. Nebraska is a state dedicated to local control, where districts are allowed to maintain their own, unique curriculums that align to either the state or a local set of standards that have been approved at the state level. Curriculum in each Nebraska district is required by NDE to be aligned across the grade levels, vertically and horizontally, and the curricular content is reviewed on a regular basis for rigor (NDE, 2016).

Instrumentation

Semi-structured interviews were be conducted with methods professors from post-secondary institutions across the state of Nebraska that provide teacher preparation programs. The semi-structured interview process was selected to allow participants the freedom to describe and elaborate on specific interview items, but also allow the interviewer to guide and direct all responses provided back to NGSS and its domains. The researcher facilitated the interview process with a series of directed questions that were designed to gather information directly related to the research questions that have been posed by this study. The responses collected through this interview process were

intended to provide the researcher with detailed information to use in the analysis process of identifying the common themes among the interviewees' responses. The interview process provided information about the professors' personal knowledge and classroom commitment to utilizing the Next Generation Science Standards. These interviews were also intended to gather information on the extension of NGSS into the K-12 classroom.

Interview items were developed in a deliberate manner to directly contribute to answering each of the proposed research questions. Information obtained through interviews provided the researcher with data that details what methods professors in Nebraska know about NGSS, and what professional development opportunities they participated in to gain this information. The interview also addressed professors' commitment to teaching the standards and communicating the vital aspects of the standards to their students. Finally the interviewer determined if the professors are observing the standards being utilized by their students in the field. Questions were developed to directly answer each of the three research questions that are being posed in this study.

Questions in section 1 of the interview found in Appendix A provided information about the professors' professional knowledge of the Next Generation Science Standards. The purpose of these questions was to provide a foundation of knowledge and to determine the extent of the professors' backgrounds with the standards. By uncovering each professor's foundation of NGSS information, the interviewer was able to better analyze, compare, correlate and the individuals' answers to subsequent interview items. Items from section #2 of the interview provided information regarding the professors' classroom commitment to teaching the Next Generation Science Standards. The purpose

of these questions was to determine how methods professors are engaging pre-service teachers with the Next Generation Science Standards. The interview questions asked for specific examples of lessons and activities that professors are using in their classrooms to teach pre-service teachers about the standards and how to use them. By determining the extent to which various professors at different institutions are implementing and exposing their students to Next Generation Science, the interviewer is better able to analyze and understand the amount of standards implementation that is being observed in the field. The last section of the interview, section # 3, evaluated the extent to which method professors are observing pre-service teachers using the information that they have been taught about the Next Generation Science standards in their student teaching and practicum field experiences. The purpose of these questions was to determine if elements of NGSS are being carried over to the classroom and then evaluate how they are being utilized or speculate as to why they are not visible.

Interview Question Development and Justification

Questions presented under section #1 of the interview were intended to elicit information about professors' knowledge, exposure, experiences, and impressions of the Next Generation Science Standards to assist in answering research question #1. Question 1a looked for specific information about professional development and training that have contributed to the professors' knowledge and understanding of the standards. This question was intended to determine the level of knowledge and experience a professor had with the standards to provide the researcher with a baseline upon which to evaluate their future responses. Question 1ai asked the professors to provide specific examples of activities, topics, and/or ideas that were presented during professional development

opportunities. This question was intended to elicit specific information about the standards themselves and how each individual has interacted with this information. Again, this provided a basis for level of knowledge. Question 1aii had professors making a correlation between their knowledge of NGSS and the way they are preparing teachers to use them in the classroom. This question was intended to determine professors' commitment to professional practice and how they are influencing new teachers.

Questions 1b i-iii, asked professors to provide a personal definition of the three dimensions of NGSS: Disciplinary Core Ideas, Crosscutting Concepts, and Science and Engineering Practices. These definitions were intended to provide a baseline of information as to how the standards have been interpreted by the professors. The definitions were be utilized throughout the interview to clarify and connect various pieces of information regarding the standards and how they are being taught. The definitions also provided a basis of comparison among interviewees to evaluate how the standards are being interpreted and their intent.

Questions 1c i-ii, were asking for professors to identify the essential components of each core dimension and explain how that information is essential to new teacher success. The question again addresses knowledge of each professor and his or her interpretation of the standards, but it also creates a connection between content and pedagogy, which has been used to create the purpose for this study.

Question 1d. asked for the professors' interpretations of the potential impacts the standards could have on education. This question provided information on professors' perceived intent of the standards, which provided insight into how teachers are approaching the standards in their classrooms with their methods students. Question di

followed up by asking how the professors' professional practices can positively influence those classroom impacts. This follow up allowed the professors to discuss their perceptions of the impacts teacher training can have on classroom performance.

Questions presented in section #2 of the interview were intended to gather information about exactly how methods professors are teaching their students about NGSS. Gathering information about specific classroom activities and lessons and then inquiring as to how those items are aligned with NGSS was important in determining how new teachers are being prepared to use the standards, which all relates to research question #2.

Question 2a asked for specific information about activities, labs, lessons, or other formats that professors have used to present information about NGSS to their students. This question provided content specific information that can be used to delve deeper into their commitment to teaching the standards and the pedagogy being utilized. Question 2ai asked for specific instructional strategies that professors are using in the classroom to carry out the activities described in question 2a. This question provides information about professional pedagogy. By following up in this manner, information was gained on professional practice. Question 2aii had professors making deliberate connections between the activities they have been discussing and one of the dimensions of NGSS. This allowed for a check in continuity of responses and ensures that professors were focused on those items that pertain directly to NGSS only.

Question 2b asked professors to quantify and qualify their instruction with regard to NGSS. This question provided information about the professors' academic commitment to teaching NGSS. By asking specifically how often and at what level the

standards were being addressed in class, the interviewer was able to determine the extent to which students were engaging with the standards in their methods courses.

Question 2c addressed the dimension of crosscutting by asking how future teachers are being taught to utilize and approach this dimension in the classroom. This question allowed for instructional practice to be tied directly to one of the dimensions of NGSS and forced professors to make intentional connections between specific components of NGSS and their pedagogy. Question 2d is similar in nature; it asked professors to connect teaching to the dimension of disciplinary core ideas and specifically inquired about the role and importance of this dimension. This question was intended to not only create a connection between instructional practice and NGSS, but also inquired about the professors' thoughts with regard to synthesizing content and increasing depth of knowledge. This is a major component for the implementation of NGSS, so asking the professors to discuss the importance and role of this dimension, a sense of value for NGSS and how that value is being portrayed for future teachers was revealed.

Question 2e addressed engineering practices and inquired about how new teachers are being taught to utilize and implement the ideas of engineering in their classrooms when they have little or no background in the area. This was a question intended to analyze pedagogy. The question implied that engineering is difficult for science teachers to approach and embed in their teaching because they lack the knowledge and skills to do it effectively. This question gave the interviewer an opportunity to gather information about how professors will teach aspiring teachers to think outside their comfort zones and buy-in to NGSS.

The questions in section 3 of the interview were designed to determine how methods professors were observing their students utilizing the dimensions of NGSS in their field experiences. These questions helped to determine if the professors' instruction was being carried over into teacher practice. Questions were sequenced to determine if NGSS was visible in practicum observation and how new teachers were presenting this information to the students in their classrooms.

Question 3a asked if the elements of the NGSS framework were visible in professors' observations of pre-service teachers in their classroom work with students. The question assisted in determining whether the instruction student teachers were receiving in their methods courses was being put into practice. Based on the answers to question 3a, when professors indicate that they were observing elements of NGSS in their observations, a series of follow up questions, 3ai, were asked to determine how this information was being presented, including what strategies, labs, activities, etc., have been observed, and how those items are specifically related to the dimensions of NGSS. This line of follow up questions was intended to gain insight into new teacher practice with regard to NGSS and to gauge if those practices were being used intentionally to achieve the goals of the standards. When professors indicated that they were not observing teachers utilizing elements of NGSS, follow up question 3aii asked them to speculate as to why this may be occurring and asks them to offer suggestions as to how this could be resolved. This question allowed professors to connect their instruction specifically to teacher practice and to elaborate as to how that connection could be made more intentionally to impact teacher practice, thus increasing the utilization of NGSS in the classroom.

Role of the Researcher

Due to the qualitative nature of this study, the researcher played a vital role in the delivery and effectiveness of the instrument. The data was being mediated through a human instrument, so the manner in which questions were presented and followed up with impacted the results of the study. The researcher has a 10-year background in science education and brought personal experiences, expectations, and biases to the interview. The researcher was aware of the potential impacts and made every effort to conduct interviews in a systematic manner in order to avoid unnecessary human interference with results and analysis.

Validation Process

A focus group that included former and current NSTA presidents, science curriculum specialists from the Nebraska Department of Education, and NGSS professional development instructors from the Bureau of Educational Research, was utilized to validate the interview instrument. Each member of the focus group was emailed an explanation of the study, the research questions posed by the study, and a list of instructions for their contributions to the validation process. The focus group participants were instructed evaluated each interview item and look for consistency, validity, and flow of information. They were asked to determine if the interview was adequate for answering each of the research questions being posed. The primary goal of the focus group was to assist in clarifying and validating interview items. Members of the group provided feedback to the researcher in the form of emails and/or Google Document comments. After all of the responses were collected the researcher called each of the focus group member individually and spoke to them over the phone to discuss their

feedback an ensure that their comments were being appropriately interpreted. Upon analysis of responses there was a general consensus that the items were well organized and the questions were designed to obtain valid and relevant information. A few suggestions were made by one focus group member to include some inquiry specific questions in the practice section (section 2) but after discussing these comments with this member we determined that those questions were outside of the scope of the study and they were not included. Another group member discovered a grammatical error in one of the interview items that was corrected and the other members of the group were informed of the change. Otherwise all of the feedback was consensual and the group members agreed that the items. By having several experts in the field look at the questions and discuss the content, flow, and goals of each question, the study was strengthened, and the interview served to adequately and accurately answer the research questions that were being posed by the study. The utilization of outside perspectives was essential to ensure that the instrument functioned as intended by the researcher and that the information being gathered was relevant.

Procedures

Subjects were interviewed in person or over the phone, and all conversations were be recorded. Questions were asked in a pre-determined sequence, and subjects were asked to elaborate and clarify as necessary to obtain adequate information for each question. In some cases, due to lack of knowledge of the part of the interviewee, certain questions were omitted for the interview protocol. Interview subjects were asked to provide a personal definition for Cross-Cutting Concepts, Disciplinary Core Ideas, and Science and Engineering Practices as they pertain to science education and NGSS. These

definitions were correlated to the definitions provided by the NGSS website to determine a sense of continuity for information provided by each interviewee. Information obtained in these interviews was intended to analyze the condition of Next Generation Science in the State of Nebraska only; it was not intended to generalize to a larger population.

Data Collection and Analysis by Research Question

Data was collected qualitatively through a semi-structured interview. Evaluating and analyzing interviewee responses and coding them for the presence of common themes, ideas, and opinions served to answer the research questions posed by the study. Collection of data through the interview process allowed the researcher to determine how much methods professors in Nebraska know about the Next Generation Science Standards, if and how they were teaching their students about the Next Generation Science Standards, and finally, if pre-service teachers who have been instructed on the use of NGSS were carrying those items over to the classroom in their student teaching experiences.

Recorded interviews were transcribed and organized by question. The information was evaluated for the presence of common themes in responses and common practices and ideas of the interview participants. These themes were the basis for answering the three research questions posed by the study. The culmination of this study provided a clear, concise analysis of how the Next Generation Science Standards were being interpreted and utilized at the post-secondary level in Nebraska. From this analysis it been determined what, if anything, needs to be re-evaluated to ensure that Next Generation Science Standards are taught and utilized to the greatest possible extent in Nebraska.

Chapter 4: Analysis of Data

Introduction

During the course of the research study, nine participants were interviewed either in person or over the phone. The interviews were transcribed in their entirety. Copies of the interview transcriptions, along with summaries of the researchers' key findings, were then sent to each interviewee for clarification and verification of information. Interviewees were given the opportunity at that time to edit their responses. Each interview transcription was organized into three sections based on the research questions posed by the study, and the key finding in each section were then summarized and included in Chapter 4 under the section Executive Summaries of Interview.

All nine interviews were then analyzed and coded to identify the presence of common themes that emerged from each section. Summaries of those themes are discussed in Chapter 4 under the section Identified Themes.

Implications, comparisons, and further discussion of interview themes are included in Chapter 5: Conclusions.

Demographics of Interviewees

Participants for this research study came from 8 of the 16 post-secondary institutions in the state of Nebraska that offer teacher preparation programs. The institutions represented were both private and public and ranged in size from large, urban universities to small, rural colleges. Experience in teaching science methods at the post-secondary level varied among the participants, with three participants identified as first

year instructors of methods, while others had anywhere from 4-25 years of experience in the field. Six of the participants taught solely for the education departments at their institutions. The other three taught primarily for the science departments at their institutions, with science methods being an additional course that they taught usually during the fall semester. All participants had taught a science methods course within the 2016-2017 school year, and six of the nine had field observation responsibilities during that time, either with student teachers or practicum students. The three participants who were not involved in student field observation had limited participation in the third section of the interview, as it pertained to pre-service teachers' observed practices in the field.

Executive Summaries of Each Interview

Each interview was analyzed for key information in each section, and those ideas, along with the full interview transcriptions, were sent to the interviewees for approval and editing. None of the interviewees chose to add any additional information to their responses, and very few changes were made to the initial information obtained during the interview process. The following is a summary of each interview that was conducted; the summaries are organized into three sections to correspond to the three interview questions that were posed by the study.

Interview 1. The participant for interview number one is a first year lecturer for the Department of Teacher Education at a large, urban institution in Eastern Nebraska. He has worked for the Teacher Education Department for the past six years and is

currently enrolled as a graduate student working on his doctorate at the same institution. His teaching responsibility for spring semester 2017 was Secondary Science Methods II.

Knowledge and Perceptions of the Next Generation Science Standards. This participant had little formal training with regard to NGSS. He attended a few national and local conferences (NSTA and NARTS) where he heard lectures or participated in sessions that discussed the dimensions of NGSS, but he proclaimed that he was self-taught through reading and the use of the NGSS website. He was very knowledgeable about NGSS and its dimensions. When asked to provide a personal definition of each of the three dimensions of NGSS, he defined Disciplinary Core Ideas as being the content portion of the standards. He referred to Science and Engineering Practices as the inquiry practices of hypothesizing, testing, and retesting. Crosscutting Concepts were identified as the unifying concepts that span across all the science content areas. The participant indicated that he believed that the role of the three dimensions of NGSS was to create alignment between content and practice. He claimed that the dimensions were foundational to science curriculum, the standards indicate what is to be taught, and that influences instruction, which influences assessment. According to the participant, new teachers need to be able to evaluate and create resources that meet the requirements of the standards. Potential impacts of the standards, according to the participant, included more exposure to inquiry at younger ages, more focus on action science, (less on vocabulary and memorization), and using evidence and data to support experimental conclusions.

Methods Classroom Practices and the Next Generation Science Standards. This participant indicated that he communicates the standards to his students by emphasizing the importance of standards alignment in lesson planning. He stressed the

significance of student products and having an interactive, hands-on classroom environment, so his students can hone their skills and practices. Finally, within a given teaching unit, he wanted his pre-service teachers to be able to identify the critical ideas and how they interconnect with each other as a means of discovering the crosscutting concepts. He indicated that his methods students spend about a third of their course time addressing standards: state, local and NGSS.

This participant addressed crosscutting concepts by showing students how to develop an essential question for each unit, and then exploring how different overarching scientific ideas are connected to that question. He emphasized the importance of having his students discover the connections themselves, so they develop this skill for their field practices. He said that students must know their content and be able to pull it out of the standards. The Disciplinary Core Ideas have streamlined content, so it will be essential for teachers to be capable of filling in the gaps and knowing how to best instruct the content. He commented that engineering is the most difficult aspect of the new standards for teachers to implement and utilize. He mentioned the possibility of incorporating an existing engineering program or set of curriculum such as robotics or Project Lead the Way to assist teachers in mastering and embracing the design, test, and redesign process of engineering and providing them with ideas and an instructional model to get started.

Classroom Observations Involving Next Generation Science Standards. As the participant reflected on his observations of student teachers and practicum students in the field he placed special emphasis on the role of cooperating teachers. His students are pre-service teachers, and when it comes to classroom instruction and content, they are

highly influenced by their cooperating teachers. He commented that in most cases, the cooperating teachers are operating solely through the Nebraska State Standards, so that is the type of delivery and content that he observes in the classroom. He claimed to be optimistic and interested to see the new Nebraska State Standards role out in 2018. The new standards for the state will be more in line with NGSS, so he hopes that will have a greater influence on current classroom teachers and will then trickle down to those who are in training.

Interview 2. The participant for the second interview was an Assistant Professor of Biology at a smaller university in Eastern Nebraska. This was her first year teaching at this institution but she had several years of prior experience teaching at a post-secondary institution in Missouri. She teaches primarily science courses in her current position, but she also co-teaches the Science Teaching Methods Course with another member of the Science Department.

Knowledge and Perceptions of the Next Generation Science Standards. This participant was well trained and extremely knowledgeable. She served on a panel of experts at her previous job in Missouri, where she taught education majors about the Next Generation Science Standards. She had formal training at the state level in Missouri on the standards, their dimensions, and the most effective forms of implementation for the classroom, but none since she has worked in Nebraska. She defined the dimension of Disciplinary Core Ideas as the core ideas of science that are found in the curriculum; she labeled this dimension as "just the facts." She identified Science and Engineering Practices as the "doing" of science, where students are investigating, producing and

questioning information. Finally, Crosscutting Concepts were defined as the interactions that exist within science. She mentioned that the Crosscutting component was a great idea, but it is not clearly communicated and is confusing for teachers.

She believed that the role of the dimensions were to assist teachers with integrating process with content. She explained that the vocabulary and layout of these standards was difficult for pre-service teachers to interpret and dissect. The standards have to be unpacked for pre-service teachers, so they are easier to work with and students truly understand how they impact instruction. This process takes the mystery out and makes the standards less intimidating. She tried to emphasize to her students that the standards are guidelines that must be interpreted and stylized by the classroom teacher. She believes that the implementation of NGSS will increase the amount of science that is happening at the elementary level because the standards mandate it in the curriculum. She has heard secondary teachers voice concerns that the unification approach to science that is laid out by NGSS will result in the "dumbing down of science." She felt that proper training was essential to ensure that teachers interpret the standards appropriately, and they can be reassured that the standards are not a threat to content.

Methods Classroom Practices and the Next Generation Science Standards. This participant taught a very small methods course, consisting last semester of just two students. She indicated that the majority of their class time together was spent in conversation and discussion. When it came to the standards, she spent a great deal of time looking through the documents with her students, dissecting the dimensions, discussing application, and assisting them in deciphering some of the unique language of NGSS.

She mentioned that with such a small group it was difficult to model implementation or have the students teach each other, which she felt was a disadvantage to her students. Instead, they watch many videos of teaching scenarios, discussed what they saw and tried to determine how the standards were being presented, or how they could be better represented in the lesson. Her methods course spends 2-3 weeks working directly with the standards, so approximately one third of the course. She felt that the crosscutting concepts dimension was difficult for her pre-service teachers to interpret and implement. There is a very high level of knowledge required on the part of the teacher to make those types of connections, and her new teachers have their focus on a lot of other instructional matters at this point in their training. She emphasized that her students are not experts at crosscutting when they leave her course, but she has them focus on the context of the material that they teach, why it matter, where it came from, to whom can it be applied, and what other ideas contribute to it.

She claimed that the design of NGSS has caused her to spend less time discussing content with her students and spend more time on implementation. In her opinion, by focusing on implementation and interpretation, the content should take care of itself, but the DCI portion of the standards is abstract and overly complicated. It is hard to read, so upon reflection, she admitted that she has neglected this area with her students. She also admitted that she believes that she is doing her students a disservice in the areas of science and engineering practices. She supports the idea and believes it to have value in the classroom, but she struggles with how to bring those practices, especially the engineering, to light for her students.

Classroom Observations Involving Next Generation Science Standards. This participant was observing student teachers for the first time during the semester in which the interview took place and had no previous experience observing student teachers or practicum students, so section 3 of the interview was omitted.

Interview 3. The participant for the third interview was a Professor of Physics and the Dean of the College of Arts and Sciences at a smaller University in Eastern Nebraska with over 22years of teaching experience at the post-secondary level. He teaches primarily science courses, but he also co-teaches the Science Teaching Methods Course with another member of the Science Department.

Knowledge and Perceptions of the Next Generation Science Standards. This participant had received no formal training with regard to the standards. He considered himself to be self-taught and had obtained knowledge from the NGSS website and by reviewing the actual standards documents. Though he was not formally trained, he was knowledgeable about the standards and had some very strong convictions about their intent and impact. He defined Disciplinary Core Ideas as the content-oriented list of things to do; essentially what a teacher going to be teaching. Science and Engineering Practices were referred to as the activities and things that scientists and engineers do. He defined crosscutting concepts as the high level abstraction in the standards that attempts to connect ideas; he also added that he didn't value this dimension and had difficulty understanding why it had been included in the standards. When asked about the role of dimensions in instruction and what new teachers should know and understand about the dimensions, he claimed that he didn't think the new standards were useful for classroom

teachers. He felt that the standards were written by "clever theorists" that were intent on showing coherence and high-level themes in science. He questioned if any of those things would actually help someone be a better teacher.

He felt that the impacts of NGSS still remain to be seen. The standards, in his opinion, have become less about what we teach and more about how we teach it. He feels that the Next Generation Science Standards have taken the debate over depth versus breadth to an extreme and have created a standards base that is a mile deep and an inch wide. The standards are too short, and much of the content has been omitted. He fears that too much is being left up to teachers to preserve the content. Also, he feels that textbook manufacturers will get on board with the standards, and we will see content removed from those resources as a result. He indicated that his instruction in his methods courses has changed since the standards were published because of the huge national push and high number of adoptions that have occurred. Locally, he also mentioned the release of the new Nebraska standards next year and how much the draft versions have manifested the ideas of NGSS. He had no qualms about saying that he hated the Next Generation Science Standards, but he attempted as much as possible to remain non-partisan when he presented them to his students and admitted that regardless of his personal opinion, this was a change that would have to be accepted and taught.

Methods Classroom Practices and the Next Generation Science Standards. When he addresses the standards in his methods courses, the vast majority of class time is spent in discussion. He attempts to help the students break down the language and look at the three dimensions and how they inner-connect in an attempt to make sense out of

the standards themselves. He has his students come up with activities and lessons that would fit into each of the standards, and they determine how they might fit into a specific course's curriculum and sequencing. He feels that the most important role that he can play for his students is to assist them in dissecting and translating the standards, so they can at least attempt to read them and understand what they mean. He indicated that he spends approximately 10% of his methods course working directly with the standards.

When we spoke at length about how the dimensions were being approached in his course and how his students were interpreting them, he said that he felt his students were not ready to tackle the crosscutting component of the standards. They are far too abstract and high-level for young teachers to understand and utilize; the students are too concerned with just getting the job done at this level to attempt to implement something this difficult. He believes that the DCI dimension is the most important of the three, and this is where he focuses his energy and time when he discusses the standards. He claimed that the DCI's inform his teachers what they need to teach and what will eventually appear on their district level assessments, so they need to know them. When he teaches his students about Science and Engineering Practices. They discuss, research, and try out different hands-on activities that could potentially transpire in the classroom. They work cooperatively in an attempt to provide authentic activities for students to create and investigate various phenomenon and answer questions. He emphasizes the need for these activities to be hands-on and involve some type of design process in order to truly incorporate engineering.

Classroom Observations Involving Next Generation Science Standards. This participant had no experience observing student teachers or practicum students so section 3 of the interview was omitted.

Interview 4. The participant for the fourth interview was an Assistant Professor of Education at a mid-sized University in Eastern Nebraska. She teaches primarily elementary courses in math and science, including elementary methods and instructional design.

Knowledge and Perceptions of the Next Generation Science Standards. This participant was unfamiliar with the Next Generation Science Standards. She had no formal training, but she did read through and review the standards when they were published. She defined the dimension of Disciplinary Core Ideas as the basic core understanding students must have. Science and Engineering Practices were the areas where students were learning to do science, and she had no definition of Crosscutting Concepts, as she was completely unfamiliar with this dimension. When asked about the role of the dimensions in instruction and learning, most of her responses were not NGSS specific. However, she did hope that the standards would encourage the use of more authentic-science in the elementary classroom, rather than just glorified art projects. She thought that the new standards would assist teachers in instructional design process, so students are getting a real science experience at the elementary level. She felt that the standards would most impact instruction by interweaving the process component and forcing teachers to incorporate the practices to meet the standards. She claimed that her biggest role with the standards was to ensure that her teachers knew what was expected

of them in terms of content, assisting them in designing lessons to effectively deliver that content, and helping them find appropriate resources to communicate that content without creating misconceptions.

Methods Classroom Practices and the Next Generation Science Standards. This participant used modeling to teach her students about the dimensions of NGSS. She spent a great deal of time modeling how science is to be taught and engaging her methods students in different types of and investigations. She wants them to experience science and ask questions, so they realize that the discipline should be more than reading and writing, and they can begin to construct their own knowledge of science instruction, regardless of how they were taught science in school. Her other role was assisting her students in unpacking the standards and explaining how the information and the practices are interconnected.

When she discussed the implementation and instruction of the three dimensions of NGSS, the crosscutting concepts section was omitted due to her unfamiliarity with this dimension. She emphasized the importance of the DCI's and having elementary teachers know and be comfortable with the content they will be teaching. She encouraged them to choose activities carefully and to avoid "this is fun" or Pinterest-based activities, as they may not address content adequately and could potentially create misconceptions. She was encouraged by the inclusion of Science and Engineering practices in NGSS and hoped that it will force elementary teachers to be more hands-on with science. She teaches this dimension by helping her teachers see the value in questioning and just wondering. She wants her teachers to help her students explore and investigate the world

around them and ask questions about things that make them curious. The experimenting and designing will come, but we first have to open students' minds and help them to think and wonder.

Classroom Observations Involving Next Generation Science Standards. As the participant reflected on her observations of student teachers and practicum students in the field, she indicated that much of what she saw or didn't see in the classroom during her observations depended on the school. A particular cooperating teacher's style and experiences influences so much of what is observed. When the cooperating teacher utilizes a hands-on performance-based science teaching style, it is much easier for her students to put their methods experiences into practice. As a result, in some cases she sees her students implementing a great deal of the standards, but in other cases she sees very little. She said that many of her students are appalled when they go out into the field that their cooperating teachers are doing exactly what she had spent an entire semester telling them not do with their students. She said that her hope it that no matter what their field experience entailed, that they would hold on to those ideas that she has instilled in them during their time in the class and choose to utilize them when they have the freedom of operating in their own classroom.

Interview 5. The participant for the fifth interview was an Assistant Professor for the School of Education at a small college in Southeastern Nebraska. She has nine years of experience teaching at the post-secondary level and she is currently teaching Science Methods for Elementary, as well as courses on Collaboration Practices and Practicum Principles.

Knowledge and Perceptions of the Next Generation Science Standards. This participant was generally unfamiliar with the Next Generation Science Standards. She had no formal training and when asked about standards knowledge, she indicated, "standards are standards." She defined disciplinary core ideas as the basics behind each of the main areas of science (life, physical, etc.). She defined Science and Engineering Practices as the opportunities for students to inquire, explore, and investigate. She was unfamiliar with the Crosscutting Concepts dimension, so no definition was provided. She did not believe that standards were the driving force behind instruction; she uses the standards to reflect a practice and provide baseline ideas for instruction, but her instruction is not centered on standards.

Methods Classroom Practices and the Next Generation Science Standards. As stated in the previous section, this participant was not focused on standards-based instruction, so most of her instructional examples were not NGSS specific and were difficult to associate with one of the dimensions. She emphasized the importance of helping teachers move beyond what the standards say to teach and explore other ideas and phenomenon. She emphasized the importance of making teachers aware of resources that are available to assist them in creating lessons and hands-on experiences for students.

Classroom Observations Involving Next Generation Science Standards. As the participant reflected on her observations of student teachers and practicum students in the field, she spoke about the increased accountability for reading, writing, and math at the elementary, and how quite often science is being neglected as a result. She indicated that what she observes is directly related to the amount of science that is

happening in that particular classroom and how it is being emphasized in that building/district at the elementary level. She claimed that she has seen elements of her instruction in classrooms where science has been made a priority, but otherwise, she has often not seen any science taught at all.

Interview 6. The participant for the sixth interview was an Associate Professor of Biology at a very small college in Eastern Nebraska. She had 23 years of experience teaching at the post-secondary level. She has primarily taught science courses, but she also teaches a course for the Education Department entitled "Teaching Science in the Elementary and Middle Grades" during the fall semesters.

Knowledge and Perceptions of the Next Generation Science Standards. This participant had limited knowledge of the Next Generation Science Standards. She had received no formal training or attended any type of professional development that pertained to NGSS. She claimed that she knew about these standards, but had not yet had the opportunity to delve into them very much. She defined Disciplinary Core Ideas as the base knowledge that the teacher would be imparting to students in the classroom. Science and Engineering Practices were referred to as the "doing" of science, involving inquiry-based practices and the collection of data. She was unable to define Crosscutting Concepts, as that was an unfamiliar area of the standards for her. She believed that the role of the standards was to provide content knowledge and let teachers know what they are expected to teach in the classroom; it was the DCI dimension that she valued and felt teachers should be most familiar with. She believed that NGSS had potential for impacting education by ensuring that science was going to get its equal share at the

elementary level. Her hope was that by incorporating more science into the standards for the primary grades, teachers would be forced to integrate more science into their curriculum because they would be held accountable for teaching it via district level testing.

Methods Classroom Practices and the Next Generation Science Standards. As stated in the previous section, this participant was very unfamiliar with the Next Generation Science Standards, so most of her instructional examples were not NGSS specific and were difficult to associate with one of the dimensions. She emphasized the importance of exposing elementary teachers to the various aspects of inquiry and hands-on learning so that they could better incorporate these ideas in the classroom. She reiterated the importance of ensuring that teachers know their content, so she made a point to talk about various scientific concepts at a very basic level in her courses; she attempted to make the content visual and break it down, so teachers know how to approach complex ideas with young learners. She claimed that the engineering aspect was very difficult for her to communicate to her students, and she had difficulty creating authentic learning experience where her teachers could see how engineering should be carried out in the classroom. She was concerned that engineering was going to be a major component of the new Nebraska Science Standards, and her only thought on how to remedy this issue was to bring in an expert or curricular program that emphasized engineering and allow those ideas to filter into the classroom to guide instruction.

Classroom Observations Involving Next Generation Science Standards. This participant had no experience observing student teachers or practicum students, so section 3 of the interview was omitted.

Interview 7. The participant for the seventh interview was a Professor of Education at a large University in Eastern Nebraska. She had been teaching science methods for over 23 years and had been a science educator for over 45 years. She was teaching elementary science methods during the semester in which she was interviewed.

Knowledge and Perceptions of the Next Generation Science Standards. This participant had no formal training with regard to NGSS. She proclaimed that she was self-taught through reading the website and various other publications on NGSS. She was very knowledgeable about NGSS and had a good understanding of the dimensions. She defined Disciplinary Core Ideas as the content knowledge portion of the standards. Science and Engineering Practices were referred to as the process skills, and Crosscutting Concepts were defined as the integration and interdisciplinary approach to science instruction. She expressed concern about her students retrofitting the standards into their lessons, as opposed to creating lessons based on the standards. As a result, the standards aren't being emphasized or utilized in the intended manner. She mandates in her courses that her students' lessons meet the national standards, so they are interacting with NGSS and are responsible for showing how those different dimensions are present in lessons. She claimed that this expectation, in combination with the complexity of NGSS, has made the retrofitting more difficult, so her hope is that this will start to fade away as a practice. She hopes that NGSS will help to ensure that science gets a greater share of

classroom time at the elementary level and that district and state assessments will reflect this type of learning so that the dimensions of NGSS will be intentionally integrated in the classroom in a meaningful way.

Methods Classroom Practices and the Next Generation Science Standards. This participant chose to address NGSS thematically with her students (Chemistry, Biology, etc.). They look at the different sciences, the content involved in teaching each area, the practices that are emphasized, and finally, the integration of those themes to create a holistic picture of science. She assists her students in deciphering the standards and determining how the various dimensions will look in the classroom. She models and works on developing open-ended lessons where students are able to explore and gather data. She commented on the importance of making elementary teachers feel comfortable with the content, so they are willing and able to teach science effectively at the primary grades.

She also spends much of time in her courses explaining the need for teachers to help students develop thinking and observation skills. She believes that the practices are one of the most difficult parts of the standards to incorporate, but the most essential. She tells her students that the content is important and will always need to be incorporated, but the skills are what set these standards apart from the rest. She was concerned that the engineering aspect has been neglected because teachers are unaware how to incorporate it effectively. She describes engineering as the process of building, constructing, manipulating and problem solving with materials. She gives her students potential projects or questions that could be answered using these techniques and puts them

through a trial and error process to help them master the design and redesign process that is truly engineering.

Classroom Observations Involving Next Generation Science Standards. It had been a few years since this participant had observed students in the field, as she was returning to the methods classroom after retirement. When she reflected back on her students' practices, she recalled that the dimensions of NGSS were visible in the classrooms she observed; whenever she held the students accountable for those aspects and evaluated them based on their ability to incorporate them effectively. When the evaluation incorporates those instructional practices, teachers will attempt to utilize them; otherwise, they will not. She was unable to provide specific examples of how the dimension were presented by the teachers she observed, as it had been several years since she was in an observation role.

Interview 8. The participant for the eighth interview was a Professor of Science Education at a large University in Eastern Nebraska. She had over 30 years of science teaching experience. She was teaching elementary and secondary science methods during the semester in which she was interviewed.

Knowledge and Perceptions of the Next Generation Science Standards. This participant had received some formal training with regard to NGSS. She regularly attended national and local conferences (such as NSTA and NARTS) where she heard lectures or participated in sessions that discussed the dimensions of NGSS. She was very knowledgeable about NGSS and its dimensions. When asked to provide a personal definition of each of the dimensions she defined Disciplinary Core Ideas as the

curriculum core that has been a part of national science standards for a very long time. She referred to the Science and Engineering Practices as the new piece of the standards that involved problem solving and process of development. And she defined Crosscutting Concepts as the dimension that involved key ideas that can be identified in all the sciences. She explained that the implementation of the standards looks different in each district, as they choose which aspects to accept and which to disregard. NGSS is very specific about what concepts should be taught at what level, but the district and/or school ultimately decides how it coincides with their current curriculum in Nebraska. According to this participant, it is difficult to assess how NGSS is influencing practice at the current time in Nebraska.

She felt that the emphasis on inquiry-based practices was the most significant aspect of NGSS. The new standards set inquiry as the primary methodology, so there will be less lecture and memorization and more investigation when these standards are put in to practice. The publishing of NGSS encouraged her department to move to a field-based program, where teachers are able to work with kids for a very extended period of time to observe inquiry-based practices in action and have coaches available to work with teachers on implementation and delivery. The goal of this change was to gain experience observing and facilitating inquiry as a teacher.

Methods Classroom Practices and the Next Generation Science Standards. This participant made it a point to engage her methods students with the standards starting on the very first day of class. The lesson plans created by the students has to align to the standards, and they had to be explicitly connected to the lesson that was being

presented. Her students taught mini-lessons to each other that involved some form of inquiry, and the class actually had to perform the activity, so they could evaluate it in terms of quality and effectiveness. They read about inquiry practices, watched videos of what it looked like in the classroom, and then they discussed the practice as a class and broke it down into digestible pieces for implementation. The dimension of crosscutting concepts was introduced from a unit planning aspect. Students were asked to design a ten-lesson unit plan, and within those lessons, they were to identify the unifying concepts and attempt to make connections to other areas of science. She explained that this process was difficult for her students at this level, and they struggled to find the connections and decide how they should be presented in the classroom.

Her focus as a methods instructor is content, process, and product. She believes that the content plays an important role, and her students must be aware of what they are expected to teach and have a good understanding of those concepts in order to impart them effectively to their students. They should also have an awareness of their grade level continuity, so they know the knowledge their students are coming in with and what knowledge they are expected to have when they leave. However, in her opinion, the process is becoming more the focus of science education based on the new standards, so that is becoming her primary focus as a methods instructor. She explained that the engineering aspect is still very much in its infancy, but courses are beginning to pop up at various school districts throughout the state, and colleges are making a concerted effort to train teachers in engineering instruction, as well. Innovation and invention programs are being developed to help teachers navigate through the engineering process and figure out how to implement them effectively in the classroom.

Classroom Observations Involving Next Generation Science Standards.

When asked to reflect about her observations of student teachers she stated that she is seeing inquiry and hands-on instruction occurring more frequently and at a much higher level than in the past. She mentioned the role of the cooperating teacher and how her students are heavily influenced by this person's instructional style. When practicum students are placed with cooperating teachers who are engaging their students in inquiry practices and attempting to incorporate the three dimensions of NGSS, her students do the same. Unfortunately, not every student can be placed in an ideal situation. She claimed that availability is an issue when it comes to placing student teachers; her institution is very large, and they place over 200 student teachers every semester, so developing relationships and making quality placements is always an issue.

Interview 9. The participant for the ninth interview was a Professor for the College of Education at a large University in Central Nebraska. She was in her third year of teaching Elementary Science Methods in this position. She also teaches courses in content-area reading, classroom management, and is the facilitator for elementary and middle-level field experiences.

Knowledge and Perceptions of the Next Generation Science Standards. This participant had gained knowledge on the Next Generation Science Standards from the science education courses that she had taken during her doctoral program. She had a professor who was very purposeful in increasing awareness of NGSS, so she integrated the three dimensions throughout her courses. She had also read several publications on the standards and purchased several books on NGSS to use in her methods courses. She

attended the NSGA Science Conferences in spring of 2015, where she took part in several seminars and discussions on the standards. She was also on the board for the Nebraska Department of Education that is in charge of the publication of the new Nebraska State Science Standards. When asked to define each of the dimensions, she identified Disciplinary Core Ideas as the primary content components from each of the areas of science. She defined Science and Engineering Practices as the exploratory, critical thinking, and problem-solving aspects of science. Crosscutting Concepts are those skills and practices that can be used and applied throughout all the sciences. She believed that it is important for pre-service teachers to expose students to a variety of topics, create applications for the real world and connect class content to other disciplines, and she believes NGSS can provides the foundation for teachers to achieve this. She believed that NGSS has the potential to renew student interest in science and move the discipline from the rut of factual learning into more of a problem solving, critical thinking type of instruction. She also hopes that the standards will serve to create more equitable opportunities for students to learn science, and science will cease to be neglected especially in the primary grades.

Methods Classroom Practices and the Next Generation Science Standards.

This participant used modeling as her primary vehicle for communicating the standards to her students. She led them in several hands-on activities, where they were interacting with each other, much like the students in their classrooms would be someday. She requires her students to document the use of NGSS dimensions in their lesson planning so they are making intentional connections to the standards and attempting to incorporate them in an authentic manner. She has her students work collaboratively to solve

problems and ask questions, so they are working and thinking like scientists. She emphasizes the importance of having students collect data and make inferences and develop questions based on that data. She facilitates class discussions wherein her students can share ideas and experiences to help each learn how to make all of this work. She has them create lessons to use in the field that are directed at specific NGSS skills and/or ideas, so they can try out their ideas and then trouble shoot how to improve the activities and the instruction.

Her methods course is pedagogically based, so she doesn't spend much time addressing content; she advises her students to do research and build up their own knowledge of the content. They must seek out the resources they need once they know what they will be responsible for teaching in their classrooms. Elementary teachers are not science experts, so instead of bombarding them with content that they may or may not be responsible for teaching, she gives them strategies to use and activities to implement, regardless of the content, so they will have to learn content on their own, but they will have a set of skills that will allow them to easily implement that content. She believes the best way to communicate science and engineering practices is to model them for students, make them less scary, show them how basic this dimension can be, and how to pull in materials to get the students designing and thinking.

Classroom Observations Involving Next Generation Science Standards. This participant once again emphasized the role of the cooperating teacher in determining what is taught and how it is delivered during her students' field experiences. She is still observing an avoidance of hands-on activities in the classroom, which affects a student

teacher's ability to demonstrate many of the strategies and skills that he or she have learned in their methods courses. She indicated that many of her student teachers get very discouraged by what they see when they get into the field. She believes that the shift in instruction that has been laid out in NGSS will be a slow learning curve for many practicing teachers, and until we can get those teachers on board, we will continue to see our new teachers struggle.

Identified Themes Across the Interviews

The following section outlines the major themes that were identified from the interview responses. It is important to note that interview participants were asked to give a definition of the three dimensions of NGSS. These definitions were intended to provide a baseline of information as to how the standards have been interpreted by the professors. The definitions were utilized throughout the interview to clarify and connect the various pieces of information regarding the standards and how they are being taught. The definitions also provided a basis for comparison among interviewees to evaluate how the standards are being interpreted and their intent. There was a general consensus that Disciplinary Core Ideas was the dimension that was addressing science content and ideas, and Science and Engineering Practices involved the doing of science: specifically involving inquiry, investigation, and exploration. These definitions were used to guide the interview process and will be further discussed in Chapter 5

The researcher coded the raw data from each of the interview summaries and grouped similar codes together to identify the themes presented. Themes were identified

and selected in an attempt to address each of the research questions being posed by this study; implications and analysis of those themes will take place in Chapter 5.

Theme 1: Professional Development Needs. At the beginning of each interview, the participants were asked to describe any professional development that they had participated in to learn about the Next Generation Science Standards. Of the nine interviewees, only three of them indicated that they had received any type of formal training on the standards. This training was obtained through attendance at state and national conferences and/or collegiate coursework. Of the other six participants, three were identified as self-taught, and three were identified as having limited knowledge of the standards. Those who were considered to be self-taught had gained information on the standards by consulting the NGSS website, reading publications, and purchasing resources on the standards. The participants who had limited knowledge of NGSS had spent little time reading or learning about the standards in any capacity; so much of their information and interpretation was speculatory in nature. There is an apparent lack of professional development and training for instructors at the post-secondary level. The awareness and knowledge of the standards was extremely inconsistent, with few of the individuals consulted able to be identified as experts or even as highly knowledgeable.

Theme 2: What are Crosscutting Concepts? Throughout the interview process, there was much confusion with regard to the Crosscutting Concepts dimension amongst the participants. Three of the nine interviewees were unable to provide a definition for this dimension in any regard. They were either unaware of this dimension all together, or they were unable to clearly identify the meaning. Those who were familiar

with the Crosscutting dimension referred to it as, “connections and interactions amongst scientific ideas.” The majority of participants expressed a concern that this dimension was extremely abstract and difficult to interpret. The language used in the standards with regards to Crosscutting was difficult to decipher and even more difficult to apply. The majority of participants believed that the level of thinking and instruction required to crosscut concepts would be virtually impossible for a first year teacher to be expected to implement. This dimension requires a high level of content knowledge on the part of the teacher, of not only his or her own content area, but of all the scientific content areas. As a result of the confusion and anxiety surrounding this dimension, over half of the participants stated that they weren’t spending a great deal of time working on crosscutting with their methods students, and they weren’t holding them accountable for utilizing it in their lesson planning and/or practicum teaching.

Theme 3: Doing Science and Elementary Exposure. When participants were asked about what they perceived to be the most significant impact that NGSS can potentially have on the way that science is currently being taught, two major ideas emerged from their responses. The first was the idea that NGSS will increase young students’ exposure to science. Five of the nine interview participants worked primarily with pre-service teachers at the elementary level. They all expressed concerns about the lack of science that is occurring in the primary grades at this time. Elementary teachers have a tendency to push science to the end of the day, so they have enough time for reading, writing, and math, and as a result, science is often neglected. Assessment drives instruction, and according to these interviewees, in most elementary schools science is not assessed at the district level, so it is easy for teachers to leave it out or dedicate little

time to it. It was their hope that with the publication and implementation of NGSS, teachers at the elementary level will be forced to incorporate more science in the early grades, as the standards are very explicit about what should be taught at each grade level. Standards are the basis for creating assessments, so if standards are adopted that mandate science at the elementary level, it is more likely to be seen on district and state level assessments, and thus will begin to transpire more consistently in the elementary classroom.

The second idea was that more hands-on, inquiry-based science will be seen in the classroom across the board as a result of NGSS. The majority of the participants were in support of the skills-based instruction model outlined by NGSS that focused on the "doing" of science. They hoped that this shift in the standards would spur this movement forward, so that educators will stop talking about inquiry and actually be held accountable for doing it. The Science and Engineering practices dimension lays the foundations for skills-based learning and encourages the use of scientific skills to solve problems, answer questions, and collect data. Engineering allows students to engage in these processes in an even more hands-on manner, where they are involved in the creation of products and the trouble shooting that goes along with the design/redesign process. The majority of participants were hopeful that gone would be the days of science being taught as rote memorization and the regurgitation of knowledge presented via lecture. They believed that NGSS had the capacity to change the traditional instructional format of science and engage students in a new, exciting way.

Theme 4: Modeling, Lesson Planning, and Unpacking. The participants were asked to describe the instructional strategies and practices that they were using in their methods courses to engage and teach their pre-service teachers about the three dimensions of NGSS. There were three modes of instruction that emerged from their responses, including the use of modeling, the emphasis on lesson planning, and the need to assist students in unpacking and deciphering the standards. Several of the interviewees emphasized the importance of modeling NGSS-based instruction for their students. These standards represent a significant shift in the way that science is to be taught in the classroom, and in order for pre-service teachers to understand and embrace these changes they have to witness them in action. These instructors are modeling inquiry-based instruction and providing opportunities for their students to participate in activities and investigations, as they would be carried out someday in their classrooms. Pre-service teachers need to know what this looks like, how to make it work, and how to trouble shoot. Modeling provides an authentic experience for pre-service teachers where they can experience hands-on instruction in person. Then, from those experiences, they can participate in discussions on how to transpose this methodology into the different areas of science and eventually be able to create investigations and activities of their own to use in the classroom. This type of instruction can be somewhat foreign to new teachers, as it is not the way they were taught science in most cases, so it is the responsibility of the methods instructor to guide them through this process and teach them how to implement it effectively.

Another instructional aspect of addressing NGSS that was discussed by several of the participants was the need to instruct students on the designing of standards-based

lesson plans. It was indicated specifically by three participants that pre-service teachers must learn to create lessons based on the standards, as opposed to creating lessons and then attempting to retrofit the standards into those lessons and forcing them to align. The standards need to be visible in all lessons and should be specifically outlined in each lesson plan to ensure that instruction aligns with the standards in an authentic manner. Instructors must begin by addressing a specific standard and facilitating discussions about how that standard will be addressed through instruction. From there, the students begin developing standards-specific lessons that incorporate both the Disciplinary Core Ideas and the Science and Engineering Practices simultaneously. By forcing the students to consult and incorporate the standards at the beginning of the planning process they are more likely to use those skills and practices that are emphasized by NGSS, and they are able to create a more fluid form of instruction for their students.

The third aspect of instruction involving the standards involved assisting students in deciphering the actual standards documents themselves. Many participants indicated that the standards are complex, abstract, and very difficult for students to read and interpret. As a result, a large portion of class time is devoted to simply unpacking the standards for the students. Instructors walk through each strand, discussing the dimensions, decoding all of the numeric indicators, determining where the standards fit into the curriculum, and attempt to identify lessons and activities that could be utilized to satisfy that particular standard. This is essential to the learning process because when these students are on their own in the classroom, they will have to be able to decipher the standards themselves, so the language and format must be discussed and clarified.

Theme 5: Role of the Cooperating Teacher. In the last section of the interview, participants were asked to reflect on their observations of students in the field. It is important to note that three of the interview participants did not participate in this portion of the interview, as they had not been involved in the observation and evaluation of pre-service teachers in the field. The majority of the participants who were able to participate indicated that the cooperating teacher was the primary influence for what they observed in the classroom, not the instruction that the students received in their methods courses. When cooperating teachers were accustomed to skills-based instruction and the various other aspects of NGSS, the interviewee was able to observe aspects of their instruction carried out by their students in the field, but if the cooperating teacher wasn't accustomed to this type of instruction, those aspects were often not observed at all.

Three of the interviewees expressed concerns over their student teachers' frustrations in the field. They were often unable to apply what they had learned in class because of the expectations and environment that had been created by their cooperating teachers. The participants emphasized the importance of student teacher placement and how critical it is that pre-service teachers are placed with cooperating teachers who provided opportunities for them to develop and utilize the skills that have been taught.

Conclusion

The data from each interview was fully transcribed for analysis and then sent to each interviewee for verification and clarification if necessary. Coding the interviewees' responses for similarities and identifying common themes with regard to the research questions posed by the study was the method of data analysis utilized by the researcher.

A summary of the interviewees' responses and a description of those themes were provided in Chapter 4 and will be discussed further in Chapter 5: Discussions and Implications.

Chapter 5: Discussions and Implications

According to an article written by NGSS authors, "College of education students need to be prepared to use, interpret, and implement NGSS in their future classrooms" (Cooper & Padilla, 2012, pg. 7). How we prepare and inform our teachers about NGSS will ultimately determine the success of these standards (Cooper & Padilla, 2012). The purpose of this study was to identify how college methods professors in Nebraska are engaging pre-service K-12 teachers with the Next Generation Science Standards and to determine if this information is being carried over to Nebraska K-12 classrooms. This study attempted to address the dearth in the literature with regard to how pre-service teachers were being trained to utilize the Next Generation Science Standards. It also served to investigate how NGSS was being interpreted and perceived by instructors at the post-secondary level, which was described in Chapter 2 as having tremendous influence over how pre-teachers are being exposed to the standards. The study attempted to address these items by answering the following research questions. First, what level of exposure and knowledge do methods professor have with regard to NGSS and what are their perceptions? Second, what specific instructional strategies are college professor's implementing to inform pre-service teachers about NGSS? Finally, are methods professors observing the three dimensions of NGSS carry over into the classroom during their students' field experiences?

Research Questions Addressed

Research Question #1. What level of exposure and knowledge do methods professors in Nebraska have with regard to the Next Generation Science Standards, and what are their perceptions of the standards? It became apparent while conducting the interviews for this study that there is a significant lack of professional learning opportunities for post-secondary professionals with regard to the Next Generation Science Standards. Very few participants had been involved in any type of training regarding NGSS. There were a few conferences that had been attended by some of the participants, but for the most part, these individuals learned about the standards by reading publications and visiting the NGSS website. One-third of the participants had essentially no knowledge of the standards, other than knowing they existed. This is alarming; as these are individuals are responsible for imparting information about the standards to our future teachers in the profession. It was indicated by several interviewees that the standards were difficult to interpret, and they struggled with knowing how to teach and implement some of the dimensions. Perhaps with adequate training, some of this confusion could be remedied, and professors could gain a better understanding of the dimensions and their intended purposes. It appeared in the data analysis that some of the resistance and avoidance of teaching the standards was in response to a lack of knowledge and understanding on the part of the professor.

One dimension in particular, Crosscutting Concepts, was a major source of confusion for many of the participants. In fact three of the participants were unable to provide even a basic definition for this dimension. For those who could, it was described

vaguely as content connection between the sciences and was often referred to as being extremely abstract and difficult to explain. One of the goals of NGSS is to bring about more cohesion in the sciences by creating connections amongst the various content areas through the identification of unifying ideas. Crosscutting concepts was the vehicle for creating this cohesion, but if professionals are unable to interpret this concept, they are not going to be able to implement it. Essentially, college professors and classroom teachers will shy away from this aspect of the standards if they are unclear about its meaning and intent. Once again, training plays a vital role in this issue. Through proper training, the Crosscutting Concepts dimension can be clarified, simplified, and modeled for professionals, so they are able to more easily communicate and implement this dimension.

In terms of perceptions, with the exception of the aspects of confusion stated above, the outlook for the impact of the standards is promising. Most the participants interviewed felt that the standards had many good things to bring to the classroom. They were optimistic about the intended impacts of these standards on instruction. Many believed that NGSS would provide the opportunity and the necessity for science to be taught in a more hands-on, engaging manner, where students will be more focused on doing science and less on memorizing. Those involved with methods at the elementary level were optimistic that NGSS would ensure that more science is taught in the primary grades in a more intentional manner. Overall the outlook was positive, and the majority of participants were in agreement that NGSS has much to offer our teachers and our students if it can be properly interpreted and implemented.

Research Question #2. What specific activities, lessons plans, and information from syllabi are being implemented by methods professors to engage pre-service teachers with NGSS? The only true instructional strategy that was emphasized by the participants as being utilized in their methods courses was modeling. Several of the interviewees were modeling NGSS-style instruction for their students and engaging them in various inquiry based, hands-on activities, so students could witness this type of instruction in action. Outside of modeling the majority of instructional time that involved the standards was devoted to deciphering the standards content. The language is very foreign, and the set up is very intimidating, so students have to be taught how to navigate, comprehend, and utilize the actual standards' documents before they can be expected to implement them properly. Along with the unpacking of the standards it appears that a great deal of time is being spent teaching students how to use the standards in lesson planning. It was described by one participant as a "standards first" approach to lesson design, so the standard is the driving force for the lesson and not the other way around. This type of lesson plan design ensures that students are intentional in their use of the standards and are not simply retrofitting the standards into existing lessons for the sake of artificial alignment.

This is a major area of concern; if the majority of class time is spent simply teaching students how to read the standards and write lesson plans with them, then time is being lost teaching them how to implement them effectively. If the standards are truly too confusing, then that is a disservice to teachers. Standards need to be succinct and easily interpreted, so teachers know what the learning goals are, and they don't have to guess. The use of standards first planning is important, and it serves to ensure that

teachers are consulting and utilizing the standards to the largest degree possible but if the interpretation component is too complex, then one has to wonder how well lessons can be designed and planned based on standards that are difficult to comprehend.

The ultimate outcome is that methods courses at this time are not utilizing a wide variety of instructional strategies or activities to teach students to incorporate the dimensions of NGSS in their classrooms. Too much time is being spent on reading the standards, and as a result, there is not enough time being spent on how to instruct with the standards.

Research Question #3. To what degree do methods professors see new teachers carrying over the three dimensions of NGSS into the classrooms in their student teaching and practicum experiences? The most accurate answer to this question based on the responses from the participants, is very little. Though the veteran professors indicated that they are seeing more inquiry-based instruction in the classroom than they used to, it is still very little compared to how much it is being emphasized in the methods classroom. The participants indicated that so much of a practicum students' performance in the field is influence by his or her cooperating teacher. Providing quality placements for student teachers is vital to ensuring that they are able to develop NGSS teaching skills in their field experiences. When cooperating teachers are not embracing this new type of instruction, then regardless of how well-educated and trained pre-service teachers have been in these practices, they will be unable to implement them; thus their skill sets will not develop, and they will be less likely to carry those skills over to their own classrooms. Identifying and recruiting high quality cooperating teachers is obviously an essential component of ensuring that students are engaging fully with the dimensions of the

standards in their practices. Placement is difficult, as a there is a lack of quality teachers who are willing and able to take on practicum students. There is a need to educate and train in-service teachers on the dimensions of NGSS to ensure that the efforts being made at the collegiate level are not going to waste in the field.

Implications for Further Research

There are several implications for further research. The most apparent is the need to investigate professional development and training opportunities that currently exist or could be created to support and train professors on NGSS. If a wide variety of these opportunities already exist, then an exploration of how to get college professionals involved in these trainings would be appropriate. If those opportunities are lacking, then perhaps an investigation of potential organizations or groups that could provide such training, going all the way back to the writers of the standards if necessary, could be conducted. It would also be beneficial to investigate the opportunities that are available for current teachers in the classroom and how to get school districts to promote these types of professional development opportunities and get science teachers involved.

Another area of investigation could be looking at the writing of the individual standards, consulting some of the writers, and beginning to break down the language, decipher the dimensions, and create some type of user's guide or handout that simplifies the content in a very succinct and efficient manner for teachers to overcome the comprehension and interpretation barrier that was so apparent throughout this study.

Conclusion

The study utilized a semi-structured interview approach to identify how college methods professors in Nebraska are engaging pre-service K-12 teachers with the Next Generation Science Standards and to determine if this information is being carried over to Nebraska K-12 classrooms. Nine science methods professors were interviewed from across the state of Nebraska. The interviews were transcribed and analyzed for common themes in responses, and those themes were then used to answer the three research questions that were posed by the study.

There were five themes identified by the research. Those themes included a lack of NGSS-specific professional development for methods professors, confusion surrounding the Crosscutting Concepts dimension, instructional impacts of NGSS include more hands-on science occurring in the classroom and greater science emphasis at the elementary level, limited instructional strategies being utilized, and finally, the influence of cooperating teachers on field experience observations. The researcher identified a need for an increase in the amount of NGSS training available for post-secondary instructors, a need to create clarity in the vocabulary and among the various dimensions of the standards, and the importance of creating quality field experience placements for our pre-service teachers to ensure a continuation for their learning. Implications for further research were explored, which included an investigation of professional development opportunities at the post-secondary level and also for in-service classroom teachers with regard to teaching in the light of NGSS. Another potential investigation could look at the writing of the standards and how to break down their language, which

could result in the development of a user's guide for navigating and decoding the standards.

This study outlined some of the perceived benefits of NGSS integration, but it also served to highlight some of the barriers that have been experienced by those who are attempting to teach and implement the standards. The study showed that NGSS is a tremendous step forward for science education and it serves to create the foundation for a new instructional model that will project students into the next generation of scientific practices and ideas. However, it also indicated there is still much work to be done to get teachers, professors, and school districts aligned with this type of instruction. Professionals must be trained on the dimensions and informed about the intent and goals of the standards in order for NGSS to move forward. The true impacts of NGSS still remain to be seen, but science education is making an effort to move in the right direction.

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Appendix

Appendix A

Interview Questions

Section1:

1. What kinds of training sessions, seminars, lectures, conferences, or any other types of professional development activities have you attended to learn about NGSS?
    i. Could you describe some activities, topics, or specific ideas that were focused on during these events with regard to NGSS?
    ii. In what specific ways have you used the training from these activities in teaching NGSS to your methods students?

2. Based on your experiences, how would you define the three dimensions of NGSS?

- Disciplinary Core Ideas
- Science and Engineering Practices
- Crosscutting Concepts

3. What do you believe are the key components that new teachers must understand in order to successfully implement these three dimensions in the classroom?

4. What do you see as the most significant impact NGSS can potentially have on the way science is currently being taught in our schools? (Value)

5. Has your instruction changed since the publication of the Next Generation Science Standards? If so, how?

6. What are the critical elements of your instruction that will help ensure that the standards are implemented appropriately and with the proper intent (have the intended impact)?

Section 2:

1. What types of activities and lessons are you using currently in your methods courses to inform students about NGSS?

    i. What specific strategies are you using to carry out these activities and lessons?
    ii. How does this activity/strategy explicitly connect to one of the dimensions of NGSS?

2. How often and at what level are your current students engaging with the three dimensions of NGSS in their methods courses? (Quantity and Quality)

3. How is the idea of crosscutting concepts being interpreted by your students and what strategies are being taught on how to approach it in the classroom?

4. How do you emphasize the importance and role of disciplinary core ideas in your classroom?

5. How can engineering practices be appropriately utilized and communicated to students by teachers with little or no engineering background or experiences?

Section 3:

1. Have you seen elements of the NGSS framework being utilized in the classroom by the teachers you have observed?

    i. If yes:

    In what ways are teachers embedding and using these new standards? What specific types of activities, labs etc. are being used, and how do they connect to the dimensions of NGSS? How is information being presented?

    ii. If no:

    Can you speculate as to why new teachers are not carrying the elements of NGSS over into their classrooms?

2. What suggestions could you make for bridging the gap between the instructional pedagogy that is being taught in methods classroom and what is actually transpiring in the classroom with students?